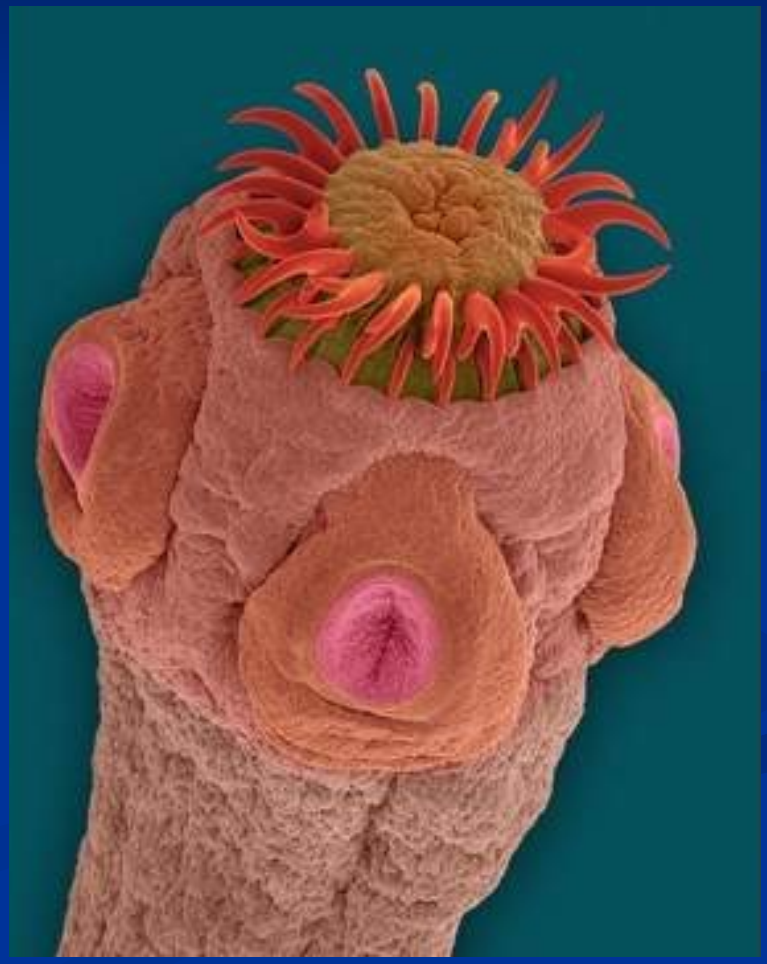
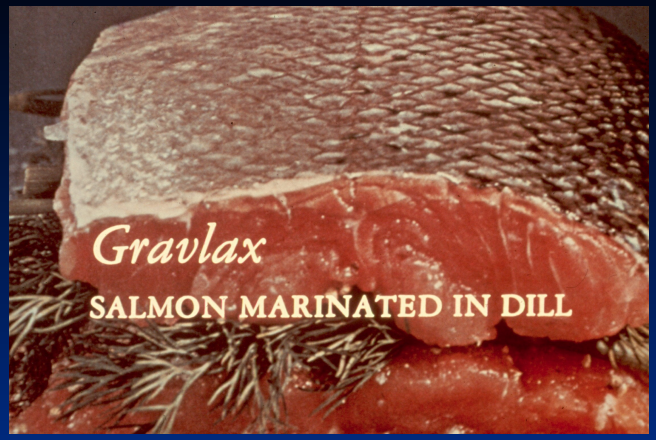
Cestodes
The Tapeworms



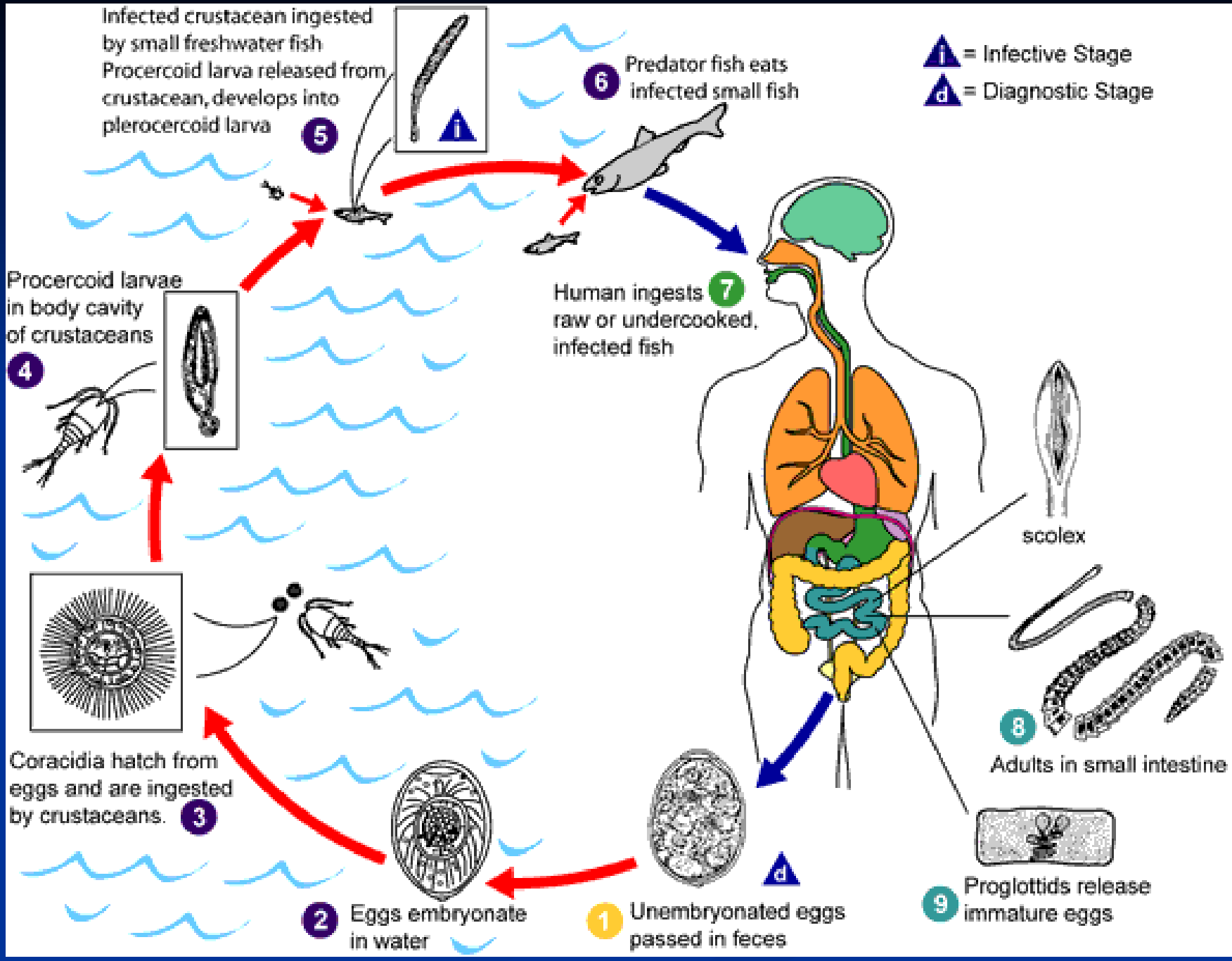
Diphyllobothrium latum



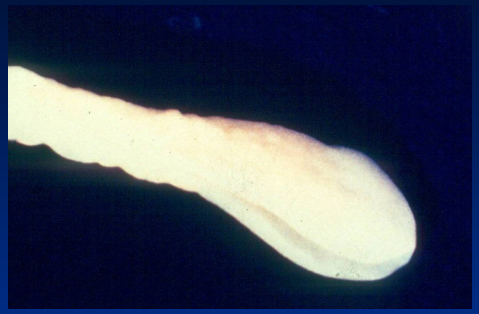
- Broad or Fish tapeworm
- Other species of *Diphyllobothrium* cause disease, but *D. latum* is most prevalent
- Worldwide, esp. Eurasia
- Reservoir in fish-eating carnivores
- Common among populations eating raw fish
- Once common among Jewish women who acquired infection from sampling gefilte fish during preparation

D. latum Life Cycle

- Eggs shed via stool enter water, coracidium released & ingested by copepod, develops to procercoid, ingested by fish, develops to plerocercoid (sparganum), eaten by human, develops to adult in human
- Paratenic hosts common (larger fish ingests smaller fish w/ plerocercoid, larva doesn’t develop further but remains infective)
- Pike, perch, salmon common sources


Infected crustacean ingested by small freshwater fish
Procercoid larva released from crustacean, develops into plerocercoid larva
5
i
6
Predator fish eats infected small fish
i = Infective Stage
d = Diagnostic Stage
Procercoid larvae in body cavity of crustaceans
4
Human ingests 7 raw or undercooked, infected fish
scolex
8
Adults in small intestine
Coracidia hatch from eggs and are ingested by crustaceans. 3
d
9
Proglottids release immature eggs
2
Eggs embryonate in water
1
Unembryonated eggs passed in feces

D. latum Morphology



- Adults up to 12 meters
- Scolex w/ 2 bothria
- Gravid proglottids are wider than long w/ a rosette shaped uterus
- Eggs
  - Operculate
  - Abopercular knob
  - 60x90 µm

Diphyllobothriasis

- PP 3-5 wks
- Usually a single worm
- No tissue damage
- Affinity for Vitamin B12, may cause megaloblastic anemia
- Fatigue, diarrhea, weakness, hunger pains
- Mild to severe anemia
  - Pallor, glossitis, dyspnea, tachycardia, neurological findings

Diphyllobothriasis Dx & Tx

- Eggs, occasionally proglottids, in stool

- Praziquantel 10 mg/kg po single dose
- Niclosamide 2g po single dose

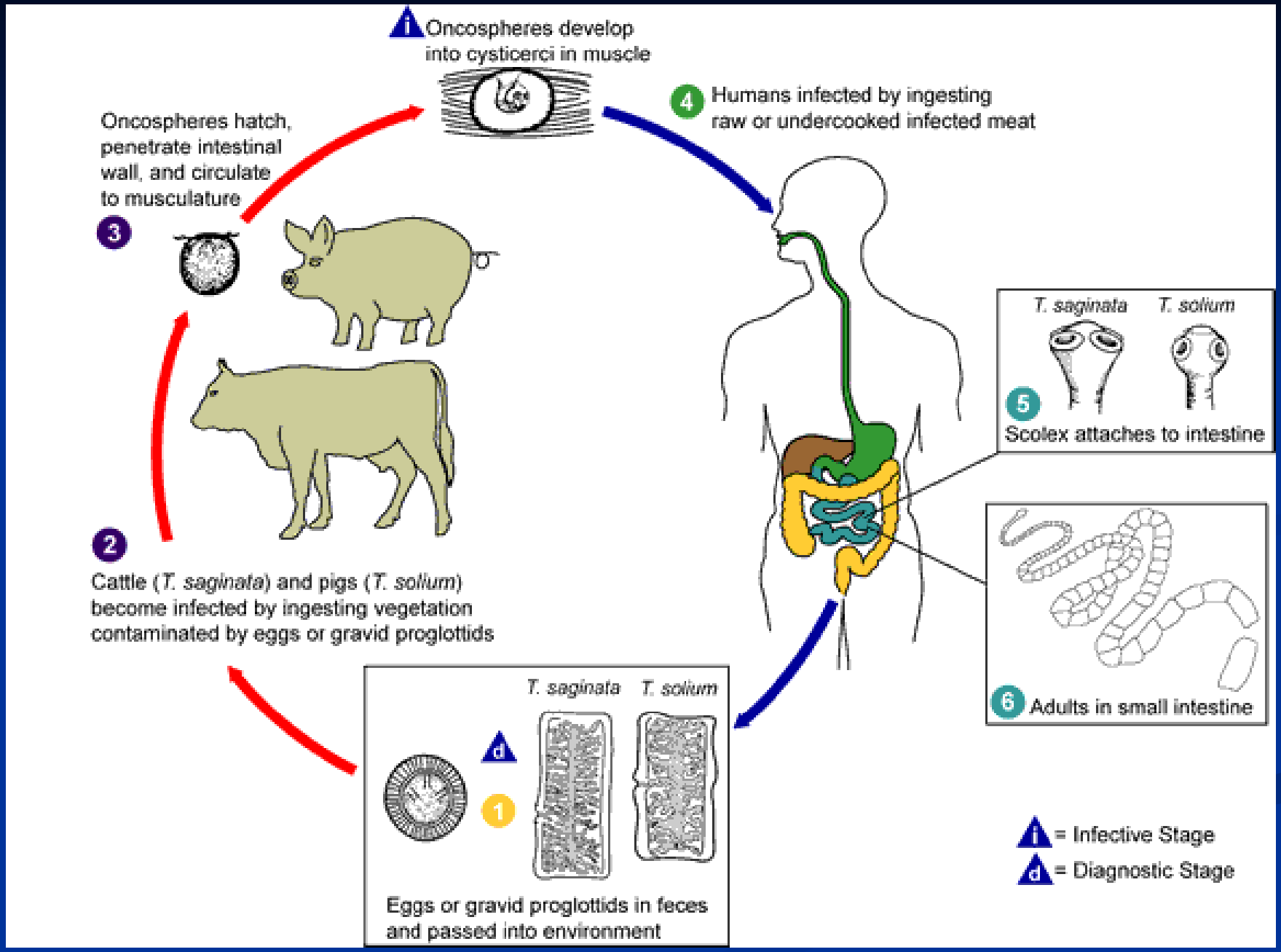
Pork & Beef Tapeworms

Taenia saginata & *T. solium*

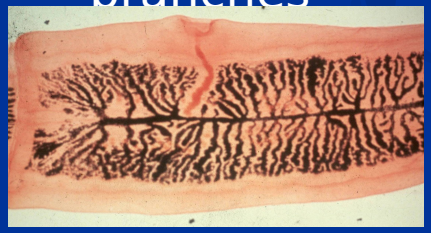
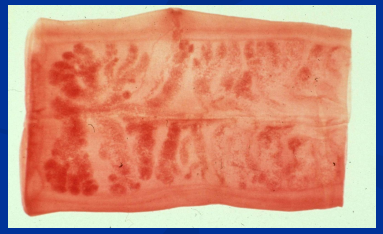
- *Taenia saginata* – Beef tapeworm
- *T. solium* – Pork tapeworm
- Worldwide distribution
- Humans acquire infection by ingestion of larval stage (cysticercus) in beef or pork
- Eggs of *T. solium* infective to humans & causes cysticercosis

Taenia Life Cycle

- Egg or proglottid shed in feces, ingested by cattle (T. sag) or pigs (T. sol), oncosphere hatches & enters gut wall, filters out via circulation into musculature, develops to cysticercus, ingested by human, evaginates and matures in gut
- PP 10-12 wks
- *T. solium* eggs INFECTIVE to humans
- *T. saginata* eggs NOT infective to humans


i
Oncospheres develop into cysticerci in muscle
4
Humans infected by ingesting raw or undercooked infected meat
Oncospheres hatch, penetrate intestinal wall, and circulate to musculature
3
T. saginata
T. solium
5
Scolex attaches to intestine
2
Cattle (T. saginata) and pigs (T. solium) become infected by ingesting vegetation contaminated by eggs or gravid proglottids
6
Adults in small intestine
T. saginata
T. solium
d
1
Eggs or gravid proglottids in feces and passed into environment
i = Infective Stage
d = Diagnostic Stage

T. saginata vs *T. solium* Morphology

	T. saginata	*T. solium*
Size	5 – 25 meters	2 – 7 meters
Scolex	rmed 4 ckers	Armed 4 kers
Gravid proglottid	15-20 uterine branches 	7-13 uterine branches 
Egg	Thick striated shell, contains 6-hooked oncosphere, impossible to speciate	

Taeniasis Intestinal Disease

- Well tolerated, may cause diarrhea, weight loss, hunger pains
- Proglottids may crawl out anus

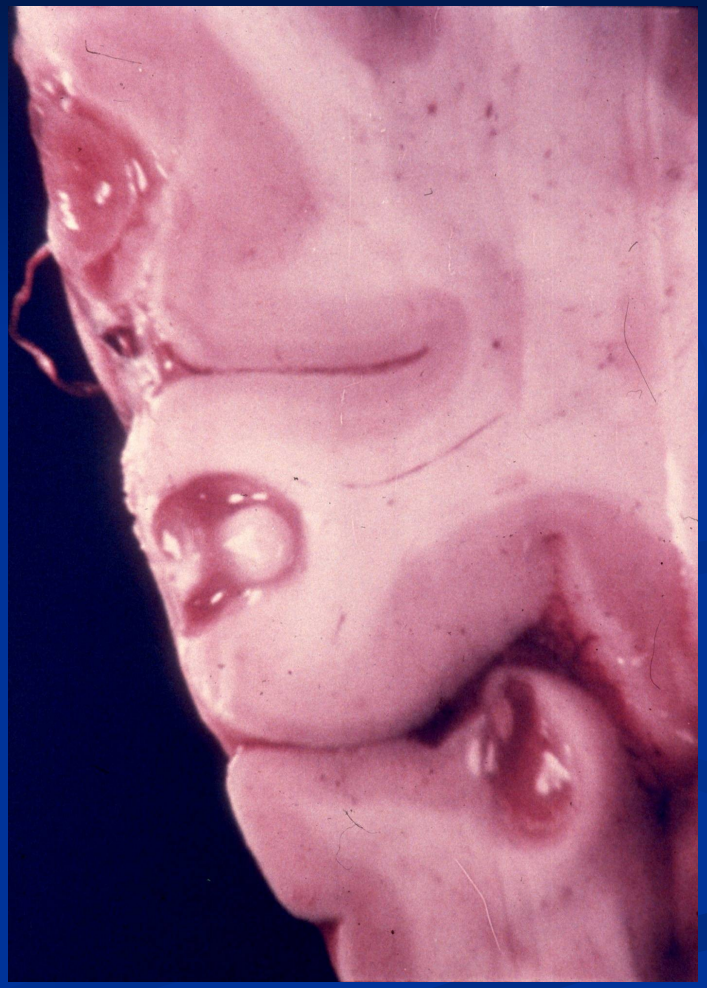
- Treat intestinal infection to avoid development of cysticercosis in patient & contacts
- Tx w/ praziquantel 10mg/kg po single dose

Cysticercosis Epidemiology

- Most common parasitic infection of the brain & most common cause of adult onset epilepsy
- Prevalent worldwide except Australasia
- In Peru, 12% of epileptic patients seropositiv
- In Mexico, positivity

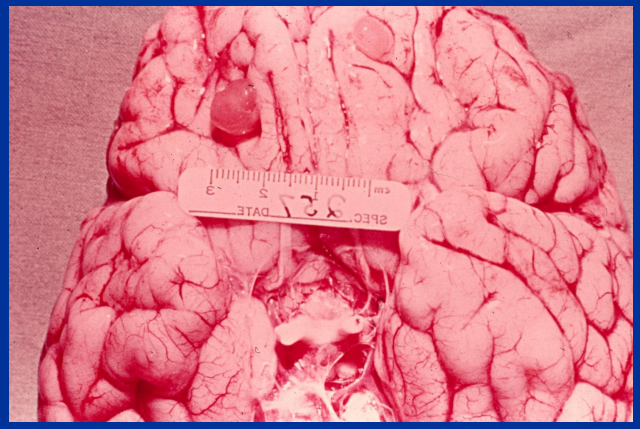
Cysticercus Morphology

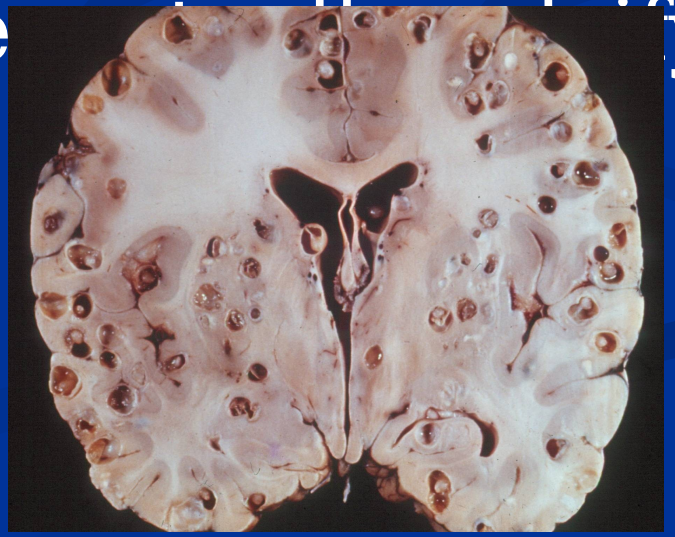
- Fluid-filled bladder w/ single inverted scolex
- 1mm – 1cm
- Racemose cysts lack scolex, will grow to fill available space, & may be degenerative form, often causes fatal disease



Cysticercosis Disease

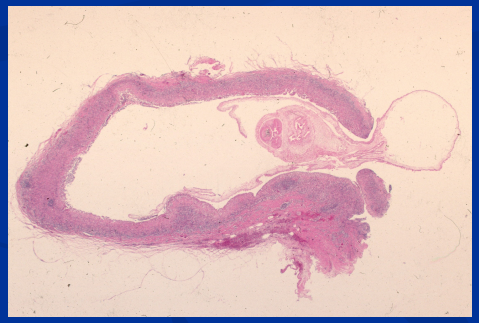
- Pathology dependent on number & location of cysts
- Viable cysts induce chronic lymphocytic & granulomatous inflammation that can last for years
- Dead/dying cysts induce acute inflammation, will e





Ocular, Muscular, & Cutaneous Cysticercosis

- Ocular
  - Cysts free in anterior or vitreous chamber, or attached to retinal tissue
  - Clouding, chorioretinitis, retinal detachment, edema, hemorrhage, disc vasculitis
- Muscular & Cutaneous
  - Occur anywhere
  - Inflammation, swelling, atrophy, calcification

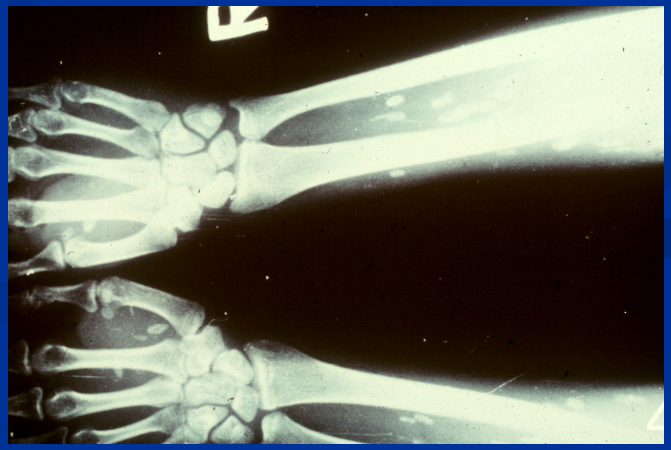


Neural Cysticercosis

- Parenchymal cysts
  - Seizures, focal deficits, hypertension
- Meningeal cysts
  - Usually basal; hydrocephalus, arterial thrombosis, stroke
- Ventricular cysts
  - Asymptomatic unless CSF flow is blocked
- Spinal cord cysts
  - Arachnoiditis, mass lesion symptoms

Cysticercosis Diagnosis

- Biopsy
- Radiology will show calcifications
- CT scans show non-enhancing hypodense 5-10mm lesions, may reveal scolex
- Viable cysts non-enhancing, dying cysts enhancing, dead cysts usually calcified
- MRI
- EITB (enzyme-linked immunotransfer blot)



Garcia H et al, Clin Micro Rev 2002 15(4):747-756

Cysticercosis Treatment

- Controversial; few controlled trials done to assess benefits of anticonvulsants alone or with antiparasitics
- General consensus: use antiparasitics to kill viable cysts; dependent on number of cysts and location
  - Praziquantel (50-75 mg/kg/d po x 2wks) or albendazole (15 mg/kg po x 8-10d)
- Calcified or enhancing lesions, if few, antiepileptics alone may suffice
- Neural & ocular disease, cysticerci death induces inflammation; give corticosteriods to control edema & hypertension if warranted

Garcia H. et al., Current Consensus Guidelines for Treatment of Neurocysticercosis. Clin Micro Rev 2002 15(4):747-756

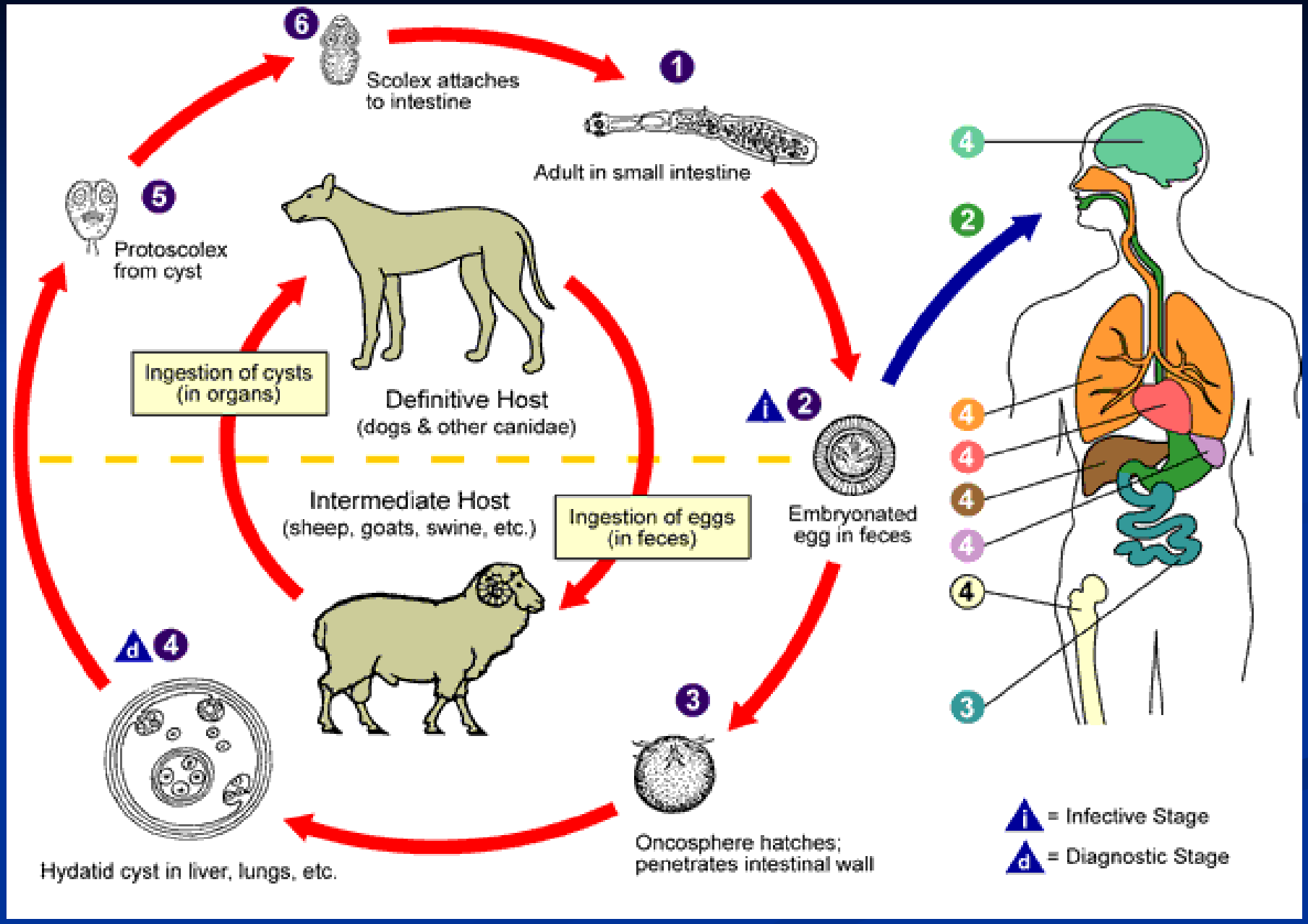
Echinococcosis
Hydatid Disease

Epidemiology

- *Echinococcus granulosus* is usual the culprit (*E. multilocularis* & *E. vogeli* occasional agent)
- Cystic hydatid disease
- Worldwide, including Western hemisphere
- 3% prevalence in Peruvian highlands, spreading over Central Europe in red fox population
- Associated with dogs & sheep & other livestock or food/water contaminated with infective eggs

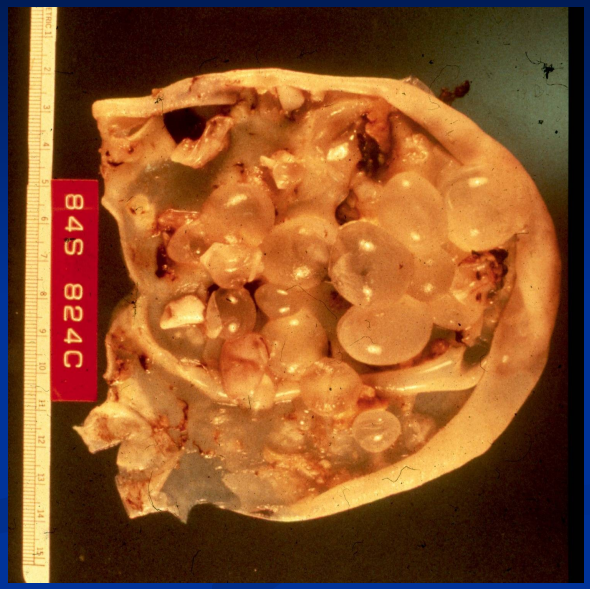
Life Cycle

- Eggs from canid shed in feces
- Ingested by livestock
- Oncosphere passes through gut wall, filters out in tissue, becomes hydatid cyst
- Meat & offal ingested by canid
- Develops to adult in gut
- Humans acquire infection by ingesting eggs

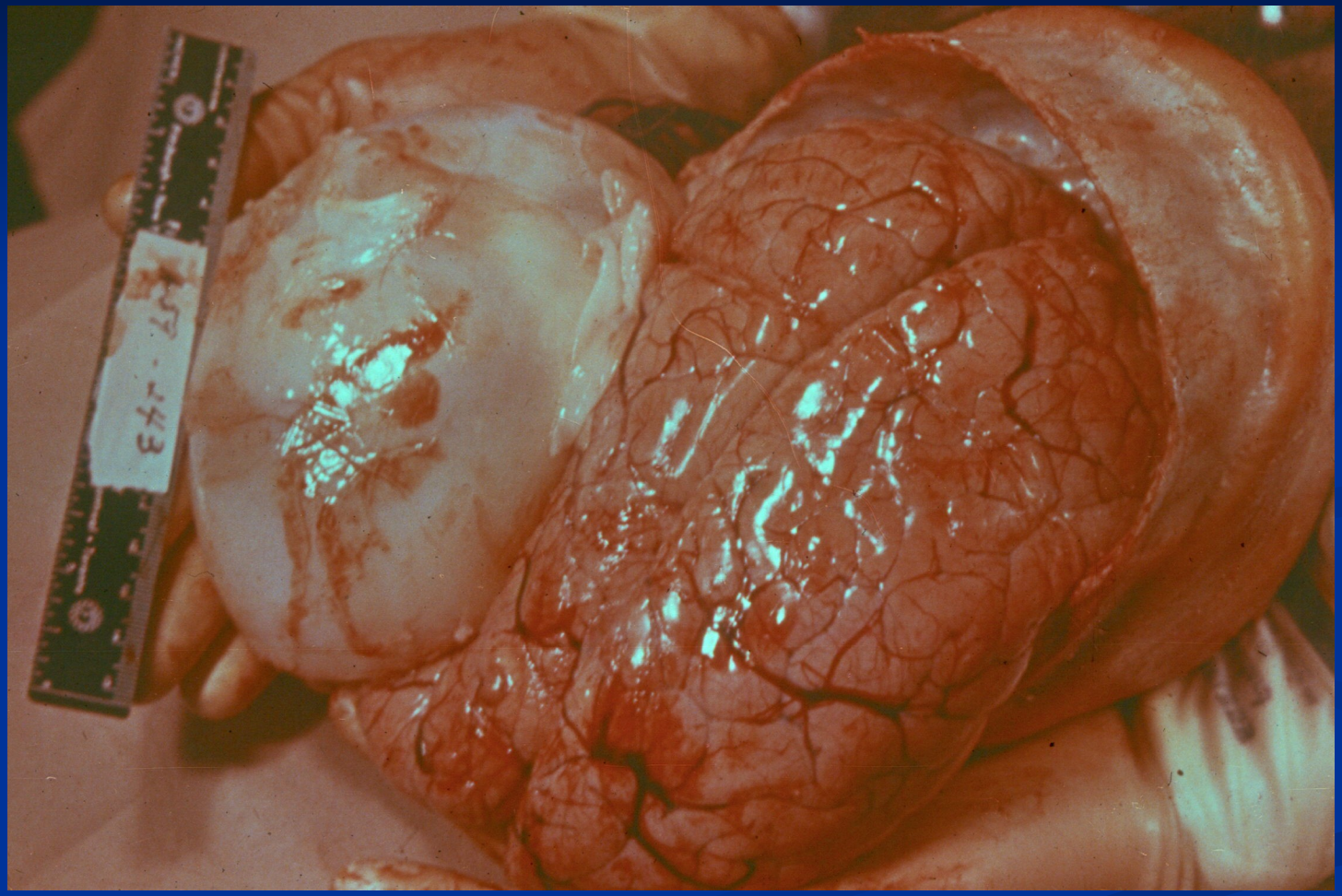

6
Scolex attaches to intestine
1
Adult in small intestine
5
Protoscolex from cyst
Ingestion of cysts (in organs)
Definitive Host
(dogs & other canidae)
i 2
Embryonated egg in feces
Intermediate Host
(sheep, goats, swine, etc.)
Ingestion of eggs (in feces)
d 4
Hydatid cyst in liver, lungs, etc.
3
Oncosphere hatches; penetrates intestinal wall
4
2
4
4
4
4
4
3
i = Infective Stage
d = Diagnostic Stage

Morphology

- Adults 3-6 mm, 3 proglottids (immature, mature & gravid)
- Eggs look like *Taenia* eggs
- Hydatid cyst
  - Single large cyst up to 20 cm w/ 2 liters of fluid containing hydatid sand (contains scoleces & capsules)
  - Brood capsules grow from germinal layer on inside cyst wall
  - Each capsule filled with numerous scoleces



Hydatid Cyst



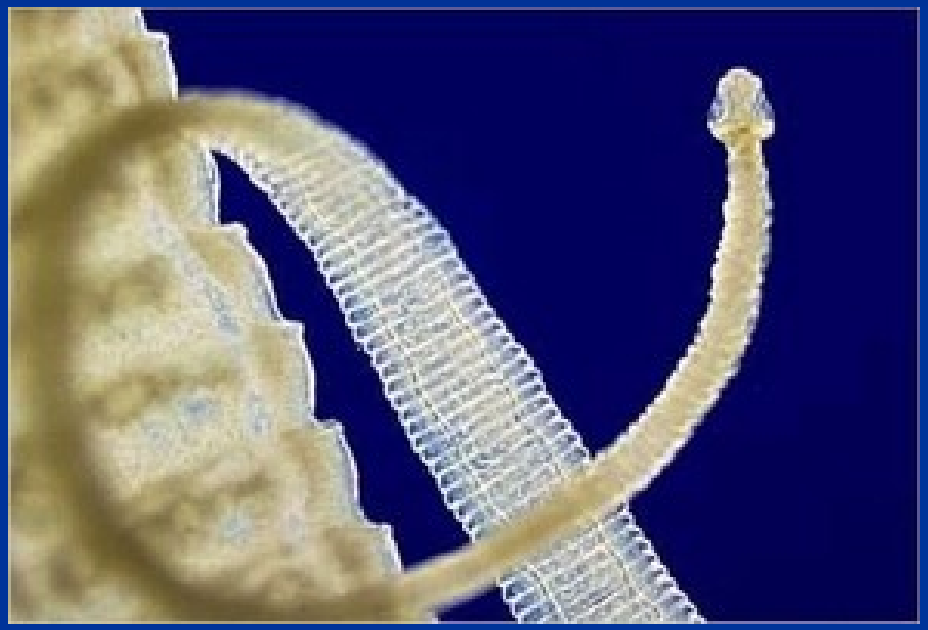
Cystic Hydatid Disease

- IP 2-20 years
- Cysts usually in liver, lungs, spleen, kidneys, heart, bone, peritoneum, CNS
- Asymptomatic until size causes dysfunction
- If ruptured
  - Severe anaphylactic shock
  - Scoleces released & can disseminate everywhere
- Pressure effects & mechanical damage
- Occasional leakage can disseminate scoleces

Cystic Hydatid Disease Dx & Tx

- Ultrasound & CT
- EITB, serology available from CDC
- Albendazole 400 mg po bid x 28d; pediatric 15 mg/kg/d divided bid x 28d
- Aspiration and/or surgical removal with care to avoid spillage of scoleces (first sterilize cyst w/ hypertonic saline, ethanol, or 10% formalin)

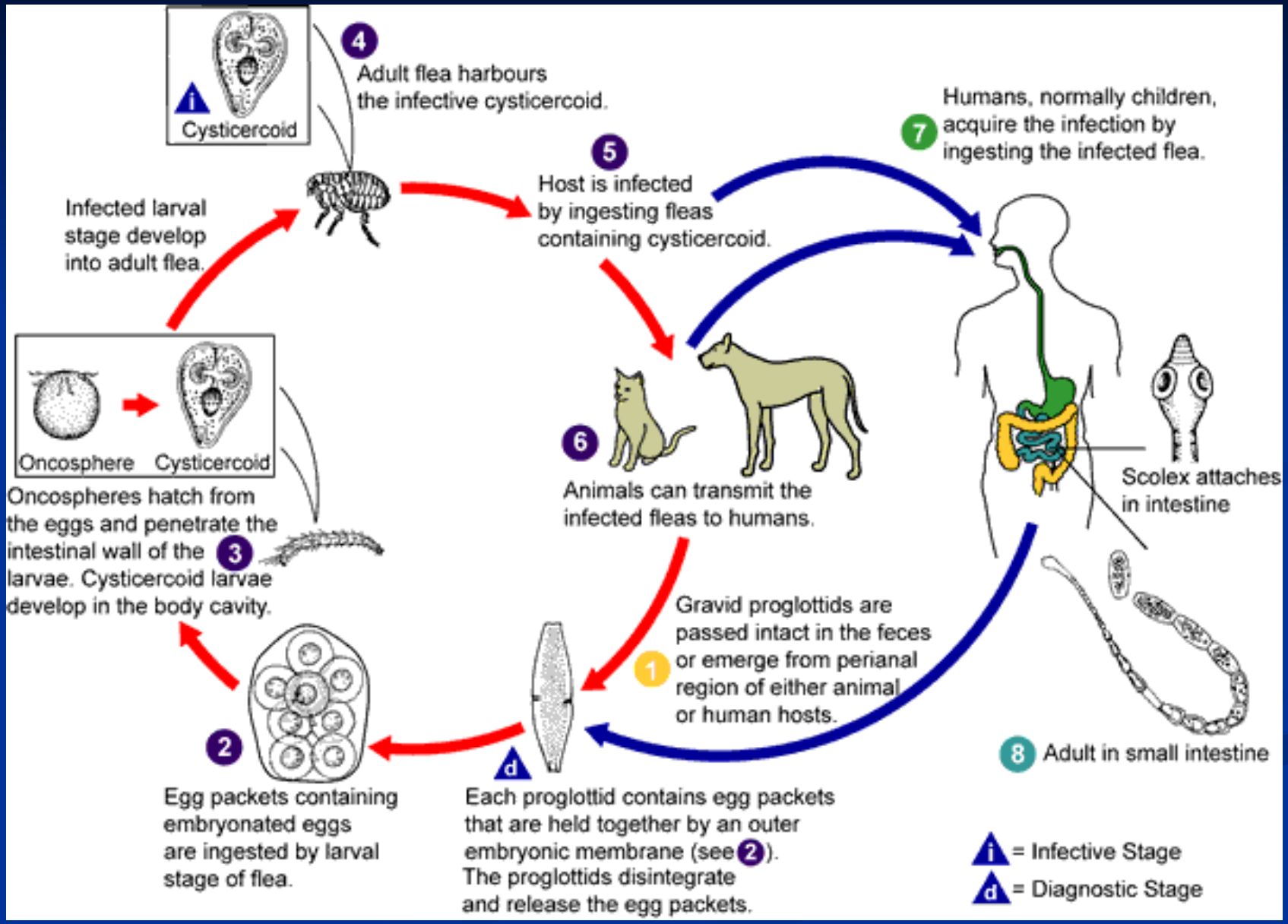
Minor Cestodes



Dipylidium caninum – Dog Tapeworm

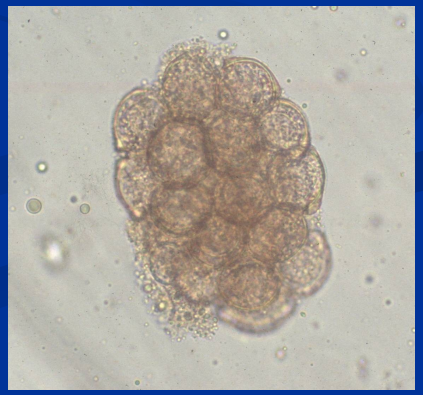
- Worldwide distribution
- Normal cycle is dog-flea-dog
- Humans acquire infection from ingestion of the larvae within a flea
- PP 1 month
- Usually asymptomatic, mild GI disturbances can occur
- In pets, pruritis caused by proglottid migration induces behavior to relieve itching (dragging anal area over grass or carpeting)

D. caninum lifecycle


i
Cysticercoid
4
Adult flea harbours the infective cysticercoid.
5
Host is infected by ingesting fleas containing cysticercoid.
7
Humans, normally children, acquire the infection by ingesting the infected flea.
Infected larval stage develop into adult flea.
Oncosphere
Cysticercoid
Oncospheres hatch from the eggs and penetrate the intestinal wall of the larvae. Cysticercoid larvae develop in the body cavity.
3
6
Animals can transmit the infected fleas to humans.
Scolex attaches in intestine
Gravid proglottids are passed intact in the feces or emerge from perianal region of either animal or human hosts.
1
2
Egg packets containing embryonated eggs are ingested by larval stage of flea.
d
Each proglottid contains egg packets that are held together by an outer embryonic membrane (see 2). The proglottids disintegrate and release the egg packets.
8
Adult in small intestine
i = Infective Stage
d = Diagnostic Stage

D. caninum

- Adults 60 cm long
- Proglottids
  - 12 mm
  - Double-pored proglottids
  - Shed individually and migrate from anus or are shed in feces
  - Highly motile & active (may be mistaken for maggots when passed)
  - Resemble sesame seeds or rice
- Eggs
  - Contain 6-hooked oncosphere
  - Usually seen in packets of 5-15 eggs
  - 35-40 µm
- Treatment with praziquantel 5-10 mg/kg once or niclosamide 2 g once (pediatric 50 mg)



Hymenolepiasis

- *Hymenolepis nana* (dwarf tapeworm) & *H. diminuta* (rat tapeworm)
- Worldwide
- Normally found in rodents with an arthropod intermediate host
- Acquired by humans when they ingest an infected grain beetle or other arthropod
- Usually asymptomatic
- Heavy infections can cause abdominal pain, headache, weakness, diarrhea

Hymenolepiasis

- Morphology
  - Adults measure 15-60 cm
  - *H. nana* eggs
    - 40-60 µm, 6 hooked oncosphere, two polar protrusions with 4-8 polar filaments
  - *H. diminuta* eggs
    - 70-80 µm, 6 hooked oncosphere, ruffled internal membrane, no filaments
- Treatment - praziquantel 25 mg/kg

Applied parasitology:

During the Paris olympics, sprinter Gilbert Velox was disqualified for "illegal use of his tapeworm".

(c)1999 Benoit Leblanc